REMARKS

The Office Action of December 18, 2007 has been reviewed and the Examiner's comments carefully considered. Claim 1 has been amended and new claims 3-7 are presented by way of this Amendment. Accordingly, claims 1-7 are currently pending in this application, and claims 1 and 3 are in independent form. Support for the amendments made herein can be found in Fig. 1, page 5, line 8 to page 7, line 15 of the Specification, and in claims 1 and 2, as filed. Applicants respectfully submit that no new matter is being added by the current Amendment.

Claim 1 stands rejected under 35 U.S.C. §103(a) for obviousness over U.S. Patent No. 6,682,657 to Dutton et al. (hereinafter "Dutton") in view of Japanese Patent Application Publication No. 2003-168941 to Outsuka et al. (hereinafter "Outsuka"). Claim 2 stands rejected under 35 U.S.C. §103(a) for obviousness over Dutton in view of Outsuka and in further view of U.S. Patent No. 5,646,657 to Aoki (hereinafter "Aoki").

The present invention is directed to a method of manufacturing a piezoelectric element. In the method, a masking agent is applied to a surface of a piezoelectric material (or a substrate made of a piezoelectric material), and the resultant film is patterned into a predetermined masking pattern, as shown in Fig. 1(a). Then, the patterned film is contacted with a vapor of a solvent for the masking agent. The film is fluidized and upheaves as domes due to surface tension, as described at page 5, line 28 to page 6, line 6 and page 6, lines 20-21 of the Specification and as shown in Fig. 1(c). The dome-shaped film is then cured, as shown in Fig. 1(d). The curing may be effected by UV irradiation. Thereafter, the piezoelectric material or the substrate is dry etched together with the cured film, forming a three-dimensional convex profile corresponding to a thickness distribution of the domed shape, as described at page 7, lines 3-7 of the Specification and as shown in Fig. 1(e).

Independent claim 1 has been amended to recite specific claim language as to the steps of "holding the film in contact with a vapor of a solvent for the masking agent . . .", "curing the dome-shaped film" and "dry etching the piezoelectric material together with the cured film . . .". Independent claim 3 recites specific claim language as to the steps of "contacting the patterned film with a vapor of a solvent for the masking agent to fluidize the patterned film into a dome shape", "curing the dome-shaped film" and "dry etching the surface of the substrate together with the cured film . . .". Applicants submit that Dutton and Outsuka, taken separately or in combination, do not teach or suggest the subject matter of

claims 1 or 3.

Dutton discloses a three-dimensional etching process for the etching of three-dimensional structures on a substrate using a reactive ion plasma as the etchant. The etching process can be applied to materials such as semiconductor materials, glass, polyimide or any other material which can be etched using a reactive ion plasma. The process includes the steps of forming a mask of resist (1) as a dome or button on a substrate (2) leaving some areas (3) on the surface of the substrate (2) exposed. This may be done by greyscale lithography or resist-reflow methods. The substrate is then subjected to a plurality of iterations of at least one resist etch followed by at least one substrate etch. As the etching process is iteratively performed, exposed areas (3) of the substrate (2) are removed and the resist (1) is reduced in size, thus exposing further areas (4) to the etchants. Repeated etching of the resist (1) and the substrate (2) eventually results in a multi-stepped structure as shown in Fig. 1(e). Also, the Dutton reference points out that under some conditions, the exothermic nature of the reactive ion etching process causes the resist to reflow. Under such conditions there may be no need for greyscale lithography or ex-situ resist reflow. Please note Figs. 1 and 2 and column 1, lines 1-5, column 1, line 28 to column 2, line 22 and column 2, lines 47-51.

Outsuka discloses a process for forming a convex surface onto a substrate of piezoelectric material. In this process, a protective film (2) is formed on a portion of the surface of the substrate and the exposed surface of the substrate is etched by using liquid etchant such as hydrofluoric acid-based etchant, forming a protruding portion. These process steps may be repeated, to form steps on the surface of the substrate. Then, the stepped substrate surface is mechanically processed using abrasive, into a convex shape.

Dutton does not teach or suggest that a patterned film of a masking agent is contacted with a vapor of a solvent for the masking agent to fluidize the film, forming domes. Rather, as noted above, Dutton teaches iterative etching of the substrate and the resist layer using reactive ion plasma. Further, Dutton does not teach or suggest curing of the dome-shaped film or dry etching the surface of the substrate together with the cured film to process the substrate into a three-dimensional convex structure or profile, as is currently claimed.

Outsuka discloses a process using liquid etchants followed by mechanical shaping of the piezoelectric element. As such, the teachings of Outsuka do not account for the noted deficiencies in the teachings of Dutton. Further rejection on these grounds would

therefore be improper.

Applicants submit that claims 1 and 3 are allowable for at least the foregoing reasons, as the teachings of the prior art of record, including Outsuka, are not sufficient to overcome the deficiencies in the teachings of Dutton with respect to claims 1 and 3.

Claims 2 and 4-7 are dependent upon independent claims 1 and 3 and are allowable for at least the same reasons as claims 1 and 3.

Further, with respect to the rejection of claim 2 based upon the Dutton and Outsuka references and in further view of the Aoki reference, Applicants respectfully submit that "[t]he Examiner must determine what is 'analogous prior art' for the purpose of analyzing the obviousness of the subject matter at issue." A prior art reference must either be in the Applicant's field of endeavor or be "reasonably pertinent to the particular problem" that the Applicants were concerned with in order to be relied upon as basis for rejecting an Applicants' claims. MPEP §2141.01(a)(I).

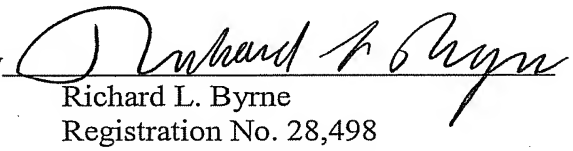
Applicants submit that Aoki is non-analogous prior art and cannot be relied upon as a basis for rejecting Applicants' claims. The claimed invention relates to the manufacture of piezoelectric elements having three-dimensional convex profiles formed thereon. An oil-repelling film is applied to a surface of the substrate to repel solvents of the masking agent from the surface of the substrate so as to reduce a surface tension of the substrate at the surface part where formation of piezoelectric elements is not intended. Please note Fig. 1(b) and page 5, lines 17-27 of the Specification.

Aoki, on the other hand, teaches the use of an oil-repellant film for the purpose of improving the dimensional accuracy of an ink jet nozzle and prevention of variations of the ejected ink drops. Please note Figs. 2 and 3 and column 3, line 30 to column 4, line 34 of Aoki. Aoki does not relate to the manufacture of piezoelectric devices or to repelling etchants from a substrate surface during an etching process.

Based on the foregoing amendments and remarks, reconsideration of the rejections and allowance of pending claims 1-7are respectfully requested.

Respectfully submitted,

THE WEBB LAW FIRM

By 

Richard L. Byrne
Registration No. 28,498
Attorney for Applicants
436 Seventh Avenue
700 Koppers Building
Pittsburgh, PA 15219
Telephone: (412) 471-8815
Facsimile: (412) 471-4094
E-mail: webblaw@webblaw.com